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ECONOMIC ANALYSIS
OF
INTERSTATE HIGHWAY ROUTINGS

FROM

CARDWELL

TO

THREE FORKS

PREPARED BY

PLANNING SURVEY DIVISION

AND

INTERSTATE DIVISION

OF

MONTANA STATE HIGHWAY COMMISSION

IN COOPERATION WITH

U. S. DEPARTMENT OF COMMERCE

BUREAU OF PUBLIC ROADS

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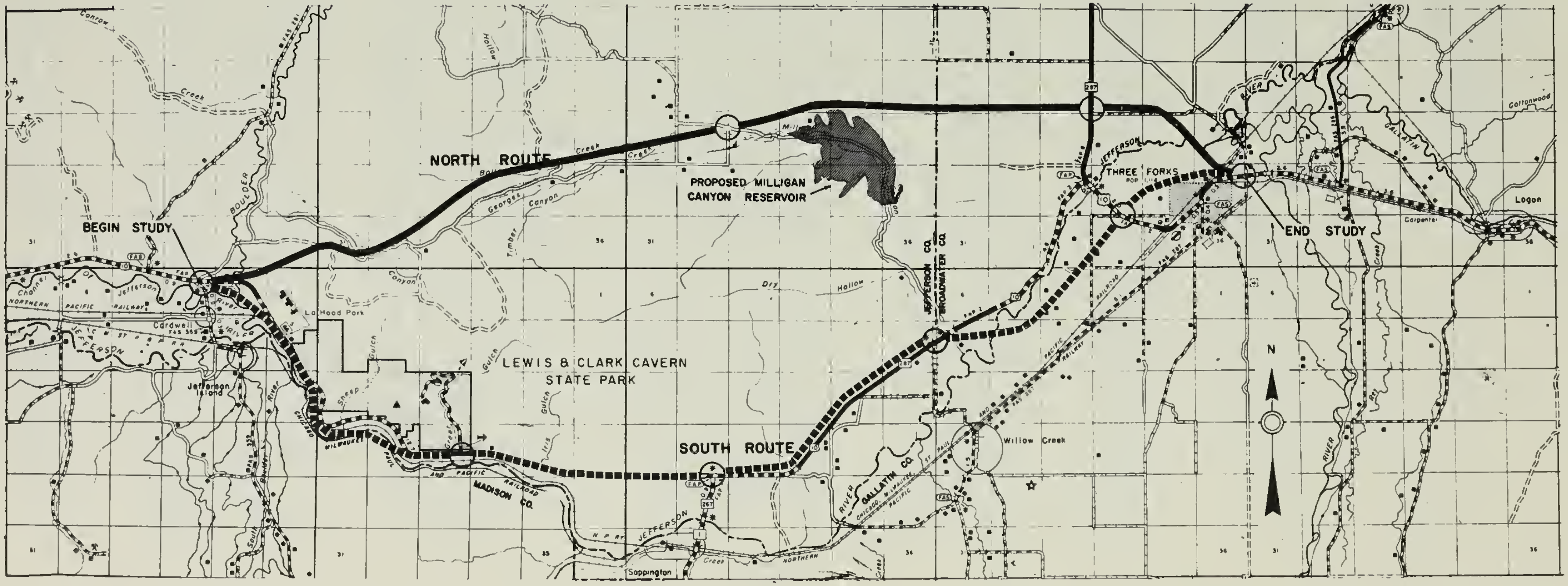
INTERSTATE 90 ROUTING
CARDWELL TO THREE FORKS

LEGEND
○ INTERCHANGE
═ SEPARATION
⊏⊐ BRIDGE



ECONOMIC ANALYSIS OF ALTERNATE LOCATIONS FOR INTERSTATE ROUTE 90 BETWEEN CARDWELL AND THREE FORKS

FOREWORD

A report of this type is prepared for the purpose of evaluating and comparing the relative merits of two or more possible locations for a new highway between points established as common termini for the alternate locations involved.

The location of a new highway is of considerable importance to three principal groups - the property owner, the business establishments and the highway user. The effect on these groups varies with circumstances, and in many instances their interests may be diametrically opposed.

The property owner is concerned for the reason that he may have to surrender land for right-of-way purposes. Although every attempt is made to provide adequate compensation for any property required, the landowner may be reluctant, for personal reasons, to sell the property. In other instances, the property owner may benefit greatly through increased value of land adjacent to the new highway, particularly in interchange and developed areas.

The owner of a business catering to highway traffic also has a substantial interest in the location of a new highway. Such businesses generally depend on proximity to and visibility from the highway as an attraction for highway trade. If a new highway is located a substantial distance from the present location, it is possible that there will be a significant loss of business, depending on the type of business involved and the location. There is no overall loss for the reason that the loss of business to one establishment will be gained by some other establishment; however, the effect on a particular establishment may be serious.

The highway user has a vital interest in the location of a new highway. The highway-user groups may be divided into two major categories: the through traveler and the local resident. The through traveler, who moves between major termini without stopping, generally benefits from the shortest route, as it reduces his travel time and expense. Exceptions occur, of course, in those instances where the shortest route may cross rough terrain involving adverse grades and curvature or where the scenic attractions may be less desirable than those on an alternate location.

The local resident, on the other hand, gains the greatest benefit when the new highway is located in the general vicinity of the present facilities. Such a location serves his normal travel patterns and keeps the overall travel distance to a minimum. He also gains the advantage of being able to travel on the higher-standard new facilities in place of the existing highway facilities. This benefit can be reduced somewhat, however, where access control features on the new highway may make it necessary for the local resident to travel an additional distance to reach a point of access.

When the new highway is entirely on new location at a substantial distance from the present highway, the local resident along the present highway may

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find it necessary to travel much greater distances in order to reach the new highway. As an alternative, he may find it more desirable to use the present highway for the major part of his travel, provided that sufficient traffic remains on the present highway to justify its retention as a public thoroughfare to be maintained to relatively high standards.

The highway user, whether he is a local resident or a through traveler, has a vital financial interest in the location of the new highway. The money for the construction and maintenance of highway facilities is derived almost entirely from State and Federal highway-user taxes paid by the motor vehicle owner and operator. For this reason, the highway user is interested in the highway location that involves the most judicious expenditure of these funds.

The highway-user taxes, however, are only a minor part of the overall cost of highway transportation to the motorist. The greatest part of the highway transportation expense occurs in the form of fuel, oil, tires, repairs, depreciation and other vehicle operating costs, exclusive of taxes. These costs exceed by many times the cost of highway-user taxes paid, and for this reason, the vehicle operating costs generally exert a greater influence on highway location than construction and maintenance costs.

It is possible that a highway location having the lowest construction and maintenance costs would involve vehicle operating costs sufficiently high that they would more than offset the advantage of lower construction and maintenance costs. It is important, for this reason, to select the highway location which involves the lowest combination of construction, maintenance and vehicle operating costs. This route would be the most favorable from the standpoint of the highway user, and unless other conditions have an overwhelming influence, this route would be recommended as the final location for the new highway.

DESCRIPTION OF ROUTES

As shown on the map in the front of this report, two principal alternate locations for Interstate Highway No. 90 have been investigated between the Cardwell vicinity and the Three Forks vicinity. Although the locations shown have been investigated in considerable detail, they represent broad-band locations in that minor deviations may be found to be desirable when the final line is selected and surveyed.

The North Route, as shown on the map, represents the most feasible direct line between the terminal points as controlled by features of terrain. The South Route has been selected as a location following along the general line of the present highway with certain deviations to meet the conditions prescribed for the Interstate System.

NORTH ROUTE

The North Route begins at the common terminus on the present highway in the vicinity of Cardwell. An interchange at this point provides access to the existing highway and also to FAS Route 359 leading to Cardwell and points south. This interchange also serves a county road leading to the north along the Boulder River. The location crosses the Boulder River through a relatively flat, irrigated valley, and on the east side of the valley, it begins an ascent to the summit of Cottonwood Creek. The present county road follows the canyon of Cottonwood Creek;

however, this is a very narrow and crooked canyon with steep cliffs of solid rock. It is completely unsuitable for an Interstate highway, and it is necessary to select a new location where curvature and grades can meet the prescribed standards.

Two locations were investigated for the North Route between the western terminus and the Milligan Creek area. One route was selected with the intent of reducing the average gradient between the western terminus and the Cottonwood Creek summit. This line extended in a northeasterly direction up the Boulder River valley on moderate grades to a point where the river was crossed. Beyond the crossing it continued up the valley on steeper grades to a point near the base of a series of cliffs. At this point the line changed to a southeasterly direction leading towards the summit.

This location crossed the prevailing drainage for most of its length and there was a substantial amount of heavy grading involved. The length of this location was about 6.1 miles from the western terminus to the summit. The average gradient was 3.2%.

Another location was investigated in the attempt to reduce both the construction length of the route and the travel distance involved. This route also avoided some of the more expensive grading and drainage involved west of the summit. This route followed an approximate direct line between the western terminus and the summit. The location took advantage of better terrain which existed in the area to the south of the county road in this vicinity. The total length of this route between the western terminus and the summit was about 5.6 miles, and the average gradient was 3.5%.

Since it was possible to keep all grades at 5.0% or less, the length was about one-half mile shorter than the other route, and the terrain was better, it was decided that the latter route would be investigated in detail as the location for the North Route between Cardwell and Three Forks.

The elevation of this North Route is about 4,300 feet at the Boulder River crossing. The summit is crossed at an elevation of about 5,260 feet and the route then descends into the Milligan Creek valley, reaching a low point of about 4,540 feet. The route then crosses another ridge at a maximum elevation of 4,680 feet and continues to descend to the common terminus east of Three Forks at an elevation of about 4,070 feet.

A construction problem area exists in the region to the west of the Cottonwood Creek summit. There has been extensive and severe faulting in this region which has exposed several ridges of vertical rock outcroppings.

On the east side of the summit, excavation will be mostly in earth, however, there may be some concealed bedrock beneath the earth mantle. At the east foot of the summit, the terrain shows a leveling tendency, and the route enters a small valley where there is a cluster of ranches in the vicinity of the Eureka School. The route follows along the edge of the developed land in this valley and passes to the north of the proposed Milligan Canyon reservoir site. At this point, the route begins an ascent over a small ridge. It then descends into the rolling terrain to the west of Montana Highway # 287 and continues south of a county road to an intersection with this highway.

East of the highway, the route follows along another county road for a short distance and enters a small drainage course leading to the proposed crossing of the Jefferson River at a point about one mile northwest of Three Forks. After crossing the river, the route passes over the C.M.St.P. & P. railroad tracks, passes through a small amount of farm land, and joins present U.S. #10 at the common terminus about one-half mile east of Three Forks.

The North Route has a total length of 21.95 miles, with 13.81 miles of two-lane highway and 8.14 miles of four-lane highway. The four-lane highway is required for 6.44 miles in the crossing of the Cottonwood Creek summit and 1.70 miles in the crossing of the ridge east of the Milligan Canyon.

The North Route crosses developed farm land in the Boulder River valley, through a portion of the Milligan Creek valley, and in the vicinity of Three Forks. The remainder of the land is used mostly for grazing purposes; however, there is some dry-land farming in the area to the west of Montana Highway #287.

Over most of the route, right-of-way should be available at a moderate cost. With the exception of the Jefferson valley, gravel for surface and base appears to be in short supply along the North Route.

Population is very sparse along the North Route with the exception of the settlement in the vicinity of the Eureka School. The Interstate highway through this area should open up a much improved travel route for the few people living in the area.

Interchanges are planned at the western terminus where connections are made with the Boulder River road, FAS Route #359 and present U.S. #10. Between this point and the intersection with Montana #287 north of Three Forks, access will be provided by at-grade intersections, with the exception of a proposed interchange near the cluster of dwellings in the Milligan Creek valley. The interchange at the intersection with Montana #287 will provide access to this important highway. The only other interchange will be located at the eastern terminus where the North Route joins present U.S. #10.

SOUTH ROUTE

The South Route begins at the common interchange near Cardwell, and extends through the bottom land along the Jefferson River. At LaHood Park the route enters Jefferson Canyon, and a transition from two-lane to four-lane standards is made.

Jefferson Canyon is a winding rock-walled canyon which the Jefferson River has carved through the limestone of the London Hills. The C.M.St. P. & P. R.R. follows the southerly side of the river through the canyon; the N.P. Ry. follows the northerly side, with present U.S. #10 running to the north of it. The fact that the narrow canyon is already occupied by two railroads and a major river makes it an extremely expensive place to build a highway to Interstate System standards.

Several alternate locations in the canyon were investigated. The line which was chosen crosses the river and both railroads four times and involves a relocation of the N.P. Ry.. The alternate lines which stay to the north of the existing N.P. Ry. were eliminated as being unfeasible because of rock excavation running into millions of cubic yards.

Approximately one mile east of the last river crossing, the line leaves the canyon and enters a wider area of the valley. At the Lewis and Clark Caverns Interchange a transition from four-lane to two-lane standards is provided. From this point to the intersection with Montana #287 leading south toward Ennis, the highway is located along the general line of the present highway. For the most part, this is through rolling terrain that does not present any special construction problems.

East of Montana #287, the South Route continues through rolling terrain, with two-lane standards, to a point of intersection with the Milligan Canyon road to the north and the Willow Creek road to the south. The location is adjacent to the present highway through this area.

Beyond the Milligan Canyon road, the South Route veers to the east and crosses the Jefferson River in this vicinity. It then continues on two-lane standards through developed farm land to a point of intersection with present U.S. #10. Beyond this intersection, the route then passes through bottom land along the river to a point north of Three Forks. In the vicinity of Three Lorks, there is a problem of location in attempting to avoid a livestock feeding enterprise. The route then crosses the C.M. St. P. & P. tracks, and it passes through developed land to the eastern common terminus about one-half mile east of Three Forks.

The total length of the South Route is 24.29 miles. This involves 19.33 miles of two-lane construction and 4.96 miles of four-lane construction.

The area to the west of LaHood Park is irrigated bottom land. The lime quarry and mining properties in Jefferson Canyon are inactive, and there is little other economic activity in the area. Rolling land which is used predominantly for grazing is encountered from the east end of the canyon to a point where the line crosses the Jefferson River approximately six miles south of Three Forks. From this point to Three Forks, the line runs through developed farm land.

Points to be served along the South Route include LaHood Park, Lewis and Clark Caverns and the intersection with Montana #287 leading south to Norris, Ennis and the Yellowstone Park area.

LaHood Park consists of a filling station, cafe, and lodging facilities. It depends largely on highway traffic. It is probable that the South Route would require the demolition or removal of this establishment.

Lewis and Clark Caverns is a State park which had an attendance of 46,848 visitors during the 1961 season. This a major attraction in this part of the state.

Montana Highway #287 is an important Primary System highway leading to the south, and it carries about 300 vehicles per day at the intersection with present U.S. Highway #10.

Other intersecting roads of interest include the Milligan Canyon road and the Willow Creek roads. The Milligan Canyon road serves about 75 vehicles per day and the Willow Creek roads serve about 100 vehicles per day, divided among the alternate connections to the present highway.

Interchanges are planned at the west terminus to serve the Boulder River road, FAS Route 359 and present U.S. #10. Another interchange will provide access to the Lewis and Clark Caverns. The next interchange will be located at the intersection with Montana # 287 leading to the south. Another interchange will be located near the Milligan Canyon road. This interchange will serve the Milligan Canyon road, the Willow Creek road and the connection with present U.S. #10 leading towards the Three Forks junction. The next interchange will be constructed at the crossing of present U.S. #10 west of Three Forks, with the last interchange being at the eastern terminus where the South Route joins the present highway.

In addition to the general area map in the front of the report, details of the location for each route are shown by means of aerial photography and profiles in the back half of the report.

CONSTRUCTION FEATURES

The following table presents a comparison of the principal construction features involved in each of the alternate routes:

	NORTH ROUTE	SOUTH ROUTE
Construction length in miles	21.95	24.29
Miles of 2-lane construction	13.81	19.33
% of total route length	63%	80%
Miles of 4-lane construction	8.14	4.96
% of total route length	37%	20%
Miles of new frontage road	1.33	-0-
Number of interchanges 1/	2	4
Number of highway separations	-0-	-0-
Number of railroad separations 2/	1	1
Number of bridges	2	6
Length of grades over 2.9% - in miles	6.25	1.52
% of total route length	28%	6%
Length of grades over 3.9% - in miles	5.11	-0-
% of total route length	23%	-0-
Maximum grade	5.0%	3.0%
Total rise and fall in feet	2,520	760
Rise and fall in feet per mile	115	31
Maximum elevation of route in feet	5,265	4,430

1/ Excluding interchanges at common termini

2/ Excluding combination bridge and railroad separations

From this table, it may be observed that the North Route is about 2.34 miles, or 10%, shorter than the South Route. The rugged terrain in parts of the North Route make it necessary that the highway be constructed to four-lane standards to comply with criteria for the Interstate System. The rugged terrain is also reflected in the fact that 28% of the total length of the route has grades in excess of 2.9%, with 23% of the route having grades in excess of 3.9%. The rise and fall of the North Route is about three times as great as the rise and fall on the South Route.

Since most of the North Route is located through sparsely populated land with light development, the local traffic is at a minimum. Most local traffic will continue to use existing county roads for short internal trips, but access to the Interstate highway for long external trips is available through the interchange in the Milligan Creek valley. Bridges are restricted to those over the Boulder River near the west terminus and the Jefferson River near Three Forks. The only railroad separation structure is located at the crossing of the C. M. St. P. & P. tracks near Three Forks. Except for the interchanges at the common termini, the only interchanges on the North Route are located in the Milligan Creek valley and at the intersection with Montana # 287 near Three Forks.

The difficulty of locating the South Route through the Jefferson River canyon is reflected in the necessity of making two dual crossings of the river and the railroad tracks in this area. Four combination bridges and railroad separation structures are required at these dual crossings. A fifth bridge is required over the Jefferson River north of Willow Creek, and a fifth railroad separation structure is required near Three Forks.

Four-lane construction is required on the South Route through the canyon area. About 20% of the total length of the South Route requires four-lane construction, as compared with 37% of the North Route.

The predominant water-level location of the South Route keeps the number of adverse grades to a minimum and reduces the amount of rise and fall as compared with the North Route.

The South Route has very little effect on the existing road network and this eliminates the need for constructing new frontage roads. The elimination of the need for new frontage roads is achieved by retaining a large part of the present highway for local service in the eastern half of the South Route. Required interchanges on the South Route are more numerous because additional principal intersecting roads must be served as compared with the North Route.

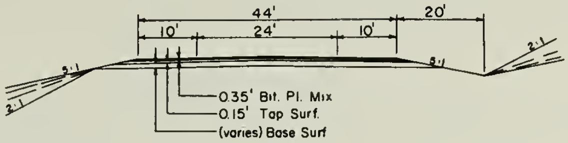
DESIGN CRITERIA

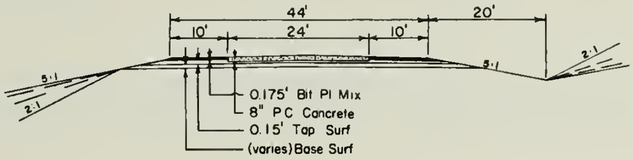
The Geometric Design Standards for the National System of Interstate and Defense Highways, the American Association of State Highway Officials "Policy on Geometric Design of Rural Highways", and the Montana Highway Commission "Field and Office Standards" were used as design standards in this study.

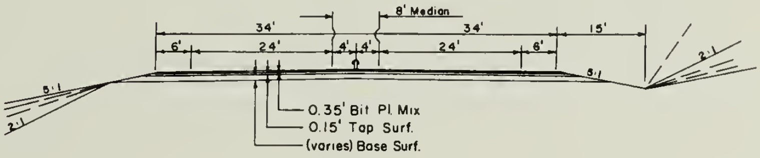
Typical Sections

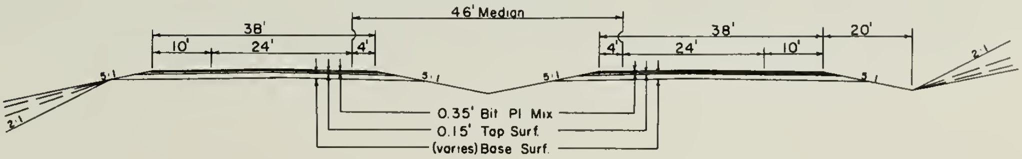
For the purposes of this report four typical sections were used.

TYPICAL SECTIONS









1. Sections N1-N2, N3-N4, N5-N6, S1-S2, S4-S5, and S5-S6 utilize a standard two-lane interstate section with bituminous pavement.

2. Sections N6-N7 and S6-S7 utilize a standard two-lane interstate section with concrete pavement. This is consistent with the pavement type being planned under similar conditions from Three Forks to Bozeman.

3. Sections N2-N3, S2-S3, and S3-S4 utilize a flush median four-lane bituminous paved section with a barrier guardrail in the median. Four lanes on N2-N3 are necessary because of steep grades. Four lanes on S2-S3 and S3-S4 are necessary because of the severe sight distance limitations introduced by restrictive vertical and horizontal curvature in Jefferson Canyon.

4. Section N4-N5 utilizes a depressed median four-lane section with bituminous pavement. Four lanes are necessary on this section because of steep grades.

Montana Highway Commission standard cut and fill slopes were used throughout this study except for Sections S2-S3 and S3-S4, where $1\frac{1}{2}$:1 and $\frac{1}{2}$:1 cut slopes were used.

ESTIMATING PROCEDURE

Earthwork Quantities

Contour maps of the entire North Route and of the Jefferson Canyon portion of the South Route (S1-S4) were prepared photogrammetrically by the Montana Highway Commission. Utilization of aerial contour maps made possible the study of all major alternates; for example, those shown in Jefferson Canyon. Once a centerline was placed on a contour map the earthwork quantities were obtained by the following method. Cross-sections were taken at appropriate intervals. Grades, typical sections, and backslope data were then entered in the IBM 650 Electronic Computer. The computer used these data to produce a tabulation of cut quantity, fill quantity, and horizontal and vertical location of catch points. With this IBM tabulation, the designer was able to judge the feasibility and cost of each line studied.

On the portion of the South Route east of Jefferson Canyon (S4-S7) the general ground profile was obtained from old road plans and other sources. Grades were laid on this profile, and earthwork quantities were computed from curves which relate height of fill or depth of cut and the cross-section elements to earthwork volumes.

Drainage

The costs of drainage structures 72" and less in diameter were based on average costs per mile. The costs of drainage and other structures over 72" in diameter were estimated individually.

Surfacing

Prices for the various surfacing sections used in this study were based on average costs per mile for similar design sections.

Separations and Bridges

The costs of the Jefferson River bridges in S2-S3 and S3-S4 were estimated by the Bridge Department. The costs of the other bridges and separations in this report were estimated on the basis of the cost per square foot of deck area for each girder type.

Right-of-Way

Right-of-way costs were obtained from a field right-of-way estimate by the Right-of-Way Division.

CONSTRUCTION COSTS

Table No. 1 shows the total estimated cost of constructing each of the alternate routes. It also shows the amortized annual cost based on the estimated service lives shown and the inclusion of interest at the rate of 6% per annum.

This table shows that the North Route has a total cost of $8,534,000, as compared with a total cost of $14,359,000 for the South Route. The difference between the total costs for these routes amountsto $5,825,000. About 75% of this difference, or $4,350,000, is due to the cost of the multiple bridges crossing the Jefferson River on the South Route.

When the total construction costs are reduced to annual construction costs on the basis of the service lives shown and interest computations at the rate of 6% per annum, the annual amortized costs amount to $608,538 for the North Route and $981,638 for the South Route. This differential of $373,100 amounts to about 61% additional cost for the South Route.

It is evident, therefore, that the North Route has a substantial advantage insofar as construction costs are concerned.

MAINTENANCE COSTS

If the North Route is to be constructed, it will be necessary to keep the present highway (U.S. # 10) in service for use of a substantial number of vehicles which will not be able to travel over the Interstate highway because of its remoteness from existing connecting highways. It will also be necessary to keep the present highway in service for travel to Lewis and Clark Caverns, a State park of considerable importance to this area.

If the South Route is to be constructed, most of the western section will be replaced by the new Interstate construction, and it will no longer be necessary to keep it in service. It will be necessary, however, to keep in service the present highway from the interchange near Milligan Canyon to the common terminus east of Three Forks.

TABLE NO. 1

COMPARISON OF TOTAL AND ANNUAL CONSTRUCTION COSTS

COST CATEGORY	ESTIMATED SERVICE LIFE	NORTH ROUTE		SOUTH ROUTE	
		TOTAL COST	ANNUAL COST*	TOTAL COST	ANNUAL COST*
Utility Adjustments	40	$ 61,000	$ 4,056	$ 194,000	$ 12,901
Grading and Drainage	40	3,794,000	252,301	4,031,000	268,062
Base and Surfacing	20	1,803,000	157,222	1,831,000	159,663
Railroad Separation	50	115,000	7,291	115,000	7,291
Interchanges	40	384,000	25,536	698,000	46,417
Bridges	50	215,000	13,631	4,565,000	289,421
Other Items	30	876,000	63,598	737,000	53,506
Subtotal - Construction		7,248,000	523,635	12,171,000	837,261
Right-of-Way	50	199,000	12,617	363,000	23,014
Engineering and Contingencies	40	1,087,000	72,286	1,825,000	121,363
TOTAL		$8,534,000	$608,538	$14,359,000	$981,638

* Annual amortized cost based on 6% interest and service lives shown.

TABLE NO. 2

COMPARISON OF ANNUAL MAINTENANCE COSTS

TYPE OF HIGHWAY	ANNUAL COST PER MILE	NORTH ROUTE		SOUTH ROUTE	
		MILES	ANNUAL COST	MILES	ANNUAL COST
Interstate - Two Lanes	$2,000	13.81	$ 27,620	19.33	$38,660
Interstate - Four Lanes	3,000	8.14	24,420	4.96	14,880
Present U.S. # 10 kept in use	1,200 1/	26.32	31,584	10.40	8,320
Frontage Roads	500	1.33	665	-0-	-0-
Extra sanding and snow removal on steep grades on the North Route	3,100 2/	8.00	24,800	-0-	-0-
TOTAL ANNUAL MAINTENANCE COSTS		57.60	$109,089	34.69	$61,860

1/ If the North Route is built, the present highway (U.S. # 10) will have to be kept in service for traffic which is not served by the Interstate highway. If the South Route is built, portions of the present highway will be kept in service; however, it will carry less traffic and of lighter average weight. For this reason, the annual maintenance cost is computed at $1,200 per mile for the North Route and $800 per mile for the South Route.

2/ In addition to the normal maintenance costs, extra expense has been charged against the North Route for the cost of extra sanding and snow removal required because of the steep grades and higher elevations at Cottonwood summit and the ridge east of Milligan Canyon.

Table No. 2 shows the estimated cost of maintaining the two and four-lane sections of the Interstate highway for both the North and South routes. It also shows the cost of maintaining the present highway and other facilities connected with the different alternate routings.

It may be noted that extra cost has been assigned to the North Route for the expense of sanding and snow removal on the sections of highway on this route which present a winter maintenance problem because of the steep grades and higher elevations. This extra cost has been computed on the basis of cost figures developed from the maintenance of other passes in the state.

Table No. 2 shows that the estimated cost of maintaining the required facilities for the North Route amounts to $109,089 per year, as compared with $61,860 per year for the South Route. This differential of $47,229 amounts to about 76% extra maintenance cost involved for the North Route. The major portion of this differential results from the necessity of maintaining the entire length of the present highway if the North Route is built and the extra cost of winter maintenance on steeper grades and higher elevations on this route.

TRAFFIC SERVICE

As stated in the foreword, service to traffic and related vehicle operating costs have an important bearing on the selection of the most favorable highway location.

The service to traffic provided by the two alternate routes has been evaluated on the basis of origin-destination surveys taken in the vicinity of Three Forks, Cardwell, Montana # 287 near Sappington Junction and Montana # 287 near Three Forks Junction. This special survey information has been supplemented by data from the regular traffic counts which have been taken on the main highway and county roads throughout the general area.

The evaluation of traffic service involves the following principal considerations:

1. Through traffic moving between Cardwell and Three Forks would use either of the Interstate routes to advantage. The North Route would have the advantage of being 2.34 miles shorter than the South Route. This advantage of shorter travel distance would be offset to some extent by the steeper grades involved for the North Route.

2. The North Route would also have the advantage of shorter travel distance and greater usage of Interstate facilities for the through traffic moving between U.S. # 10 east of Three Forks and Montana # 287 north of the Three Forks Junction.

3. The North Route would be of no value to traffic moving between Montana # 287 south of Sappington Junction and either Cardwell or Three Forks. Such traffic would not be able to reach the North Route because of its remoteness, and this traffic would have to continue using present U.S. # 10 between these points. Since the South Route would be located on about the same line as the present highway, this traffic would have direct access to the Interstate highway, and it would enjoy the benefits of using these higher-standard facilities.

4. The same situation of better service from the South Route would also apply to traffic to and from the Lewis and Clark Caverns.

5. Traffic with stops in Three Forks would have to continue using the present highway for such a movement; however, the South Route would have the advantage of less travel on the present highway and greater travel on Interstate facilities. From the standpoint of local business interests, the South Route would be best because of its greater proximity to the city.

6. The North Route would provide greatly improved service for the external trips of the local residents in the Milligan Creek valley. Internal trips in the valley could be expected to continue using the present county road. The South Route would have some benefit for the local residents in this valley to the extent that the external travel could be performed on Interstate facilities in place of the present highway after reaching the proposed Milligan Canyon interchange on the South Route.

7. The South Route would also provide a minor advantage to local residents in the Willow Creek area who would be able to use Interstate facilities, in part, for travel to and from this developed area.

As a part of the traffic assignment process and evaluation of service, the various types of trips were analyzed to determine how they would be affected under each of the Interstate highway routing proposals. Certain trips would be able to use the Interstate routes for all travel between points; other trips would be able to use the Interstate routes for only part of the travel. In some instances, all travel would have to be performed on existing county roads or present Primary highways because of the lack of access to the Interstate route involved.

Table No. 3, under the section on VEHICLE OPERATING COSTS, shows the amount of traffic using the different types of facilities under present conditions, and it also shows the distribution of this traffic under each of the alternate Interstate System routing proposals.

VEHICLE OPERATING COSTS

Vehicle operating costs per mile of travel have been computed separately for passenger cars and trucks on the basis of data obtained from numberous sources. Basic operating cost figures for level, tangent operation have been adjusted, as required, to compensate for the grades and curvature involved on each route.

The following table shows the range of operating cost figures for each type of facility, as adjusted for grades, curvature and other conditions involved.

TABLE NO. 3

TRAFFIC SERVICE AND ANNUAL OPERATING COSTS

TYPE OF FACILITY	LENGTH IN MILES	AVERAGE DAILY TRAFFIC	ANNUAL VM OF TRAFFIC	COST PER MILE	ANNUAL OPERATING COSTS
PRESENT CONDITIONS:					
U.S. # 10	26.32	1,332	12,796,258	$.1546	$1,978,302
Montana # 287 1/	1.50	992	543,120	.1401	76,091
Subtotal - Primary	27.82	1,314	13,339,378	.1540	2,054,393
County Roads	21.70	48	380,184	.1609	61,172
Total - All Facilities	49.52	759	13,719,562	$.1542	$2,115,565
NORTH ROUTE:					
U.S. # 10	26.32	425	4,082,890	$.1295	$ 528,734
Montana # 287 1/	1.50	373	204,218	.1444	29,489
Subtotal - Primary	27.82	422	4,287,108	.1302	558,223
Interstate	21.95	1,020	8,171,985	.1472	1,202,916
Subtotal - State Highways	49.77	685	12,459,093	.1414	1,761,139
County Roads	21.70	10	79,205	.1633	12,934
Total - All Facilities	71.47	480	12,538,298	$.1415	$1,774,073
SOUTH ROUTE:					
U.S. # 10	21.04	168	1,290,173	$.1458	$ 188,107
Montana # 287 1/	1.50	848	464,280	.1430	66,392
Subtotal - Primary	22.54	214	1,754,453	.1451	254,499
Interstate	24.29	1,209	10,718,813	.1368	1,466,334
Subtotal - State Highways	46.83	730	12,473,266	.1380	1,720,833
County Roads	21.70	48	380,184	.1609	61,172
Total - All Facilities	68.53	513	12,853,450	$.1386	$1,782,005

1/ The section of Montana # 287 north of Three Forks Junction to the interchange on the North Route.

UNIT VEHICLE OPERATING COSTS

TYPE OF FACILITY	PASSENGER CARS		TRUCKS	
	HIGH	LOW	HIGH	LOW
Present U.S. # 10	$.1405	$.1091	$.4012	$.3115
County Roads	.1485	.1485	.2228	.2228
North Route - Interstate	.1022	.1002	.3269	.2925
South Route - Interstate	.1022	.0988	.2968	.2854

Table No. 3 shows the total annual vehicle operating costs which have been computed for present conditions, the North Route proposal and the South Route proposal on the basis of the vehicle miles of traffic served by each type of facility and the related average unit vehicle operating costs.

The following conclusions may be drawn from the data contained in Table No. 3:

1. Both the North Route and the South Route save the highway user substantial amounts of annual travel and annual vehicle operating costs.

2. Since the North Route deviates considerably from the location of the present highway and intersecting highways, it diverts a smaller proportion of traffic to the new Interstate highway. This route serves about 65% of the total traffic involved, but it leaves about 32% of the present Primary System traffic on existing highways. The greater part of the truck traffic is diverted to the new Interstate highway, so this reduces the average unit operating cost for the lighter traffic remaining on the present highways.

3. The South Route follows substantially the location of the present highway, and in doing so, it serves a greater proportion of the total traffic involved. The South Route serves 83% of the total traffic involved, and it leaves only 13% of the present Primary System traffic on the existing highways.

4. As the result of the steeper grades involved on the North Route, the unit operating costs for this route are about 8% higher than similar costs on the South Route, which follows a general water-level grade.

5. Despite the fact that the North Route serves a lower proportion of the total traffic and has a higher average unit operating cost, it has a lower annual vehicle operating cost total than the South Route. This occurs principally for the reason that this route is 2.34 miles shorter than the South Route, and this reduction in travel distance more than offsets the other disadvantages.

6. The differential in favor of the North Route in vehicle operating costs amounts to $7,932 per year. This is a differential of less than 0.5%,

so for practical purposes, it may be assumed that the overall traffic service is about equal for both routes, and the decision regarding the preferred Interstate highway location must depend on other factors.

SUMMARY

The following table presents a comparison of the annual construction costs, annual maintenance costs and the annual vehicle operating costs pertaining to each of the alternate highway locations.

COMPARISON OF TOTAL ANNUAL COSTS

	NORTH ROUTE	SOUTH ROUTE
Annual Construction Costs	$ 608,538	$ 981,638
Annual Maintenance Costs	109,089	61,860
Subtotal	717,627	1,043,498
Annual Vehicle Operating Costs	1,774,073	1,782,005
TOTAL	$2,491,700	$2,825,503

This summary shows that the North Route saves $373,100 per year in construction costs, costs $47,229 more per year in maintenance costs, and saves $7,932 per year in vehicle operating costs. The net result is a savings of $333,803 per year in favor of the North Route. This amounts to a differential of 13% in favor of this route.

Another aspect which should be considered as part of the overall situation is the probability that it will be necessary, at some future date, to reconstruct all or essential portions of the present highway which must be kept in service for use of traffic which will not be able to utilize either of the Interstate routes.

The figures in the foregoing table and Table No. 2 are premised on the assumption that it will be possible to maintain the present highway indefinitely. Since the greater part of this highway was constructed during the period of 1929 to 1932, it is evident that it is approaching the end of a normal service life. For this reason, the situation should be evaluated on the assumption that reconstruction will probably be necessary at some time during the estimated service life of the Interstate construction.

As previously explained, the construction of the North Interstate Route will require that the entire length of the present highway be kept in service for the benefit of traffic which cannot use the Interstate highway. The traffic remaining on the present highway ranges from a high of 763 vehicles per day for one section to 268 vehicles per day for the lowest section. The average is 425 vehicles per day for the entire distance. This amounts to about one-third of the present traffic on this highway.

If the South Route is constructed, the majority of the road from the

Milligan Canyon intersection west will be replaced by the new Interstate construction. The remainder of the highway from Milligan Canyon east to Three Forks will have to be kept in service. This section of highway will carry an average of 416 vehicles per day, based on present traffic volumes.

The cost of reconstructing the present highway is estimated at $175,000 per mile for the section through the Jefferson Canyon. The cost of reconstructing the remainder of the present highway is estimated at $115,000 per mile.

When these reconstruction cost figures are applied to the entire 26.3-mile length of the present highway between Cardwell and Three Forks, the total cost amounts to $3,204,500. With an estimated service life of 30 years and interest at the rate of 6%, the annual amortized cost is $232,646 which is chargeable against the North Route.

Reconstruction of the 10.4-mile section of the present highway between Milligan Canyon and Three Forks amounts to $1,196,000. Applying the same 30-year service life and 6% interest produces an annual amortized cost of $86,829 which is chargeable against the South Route.

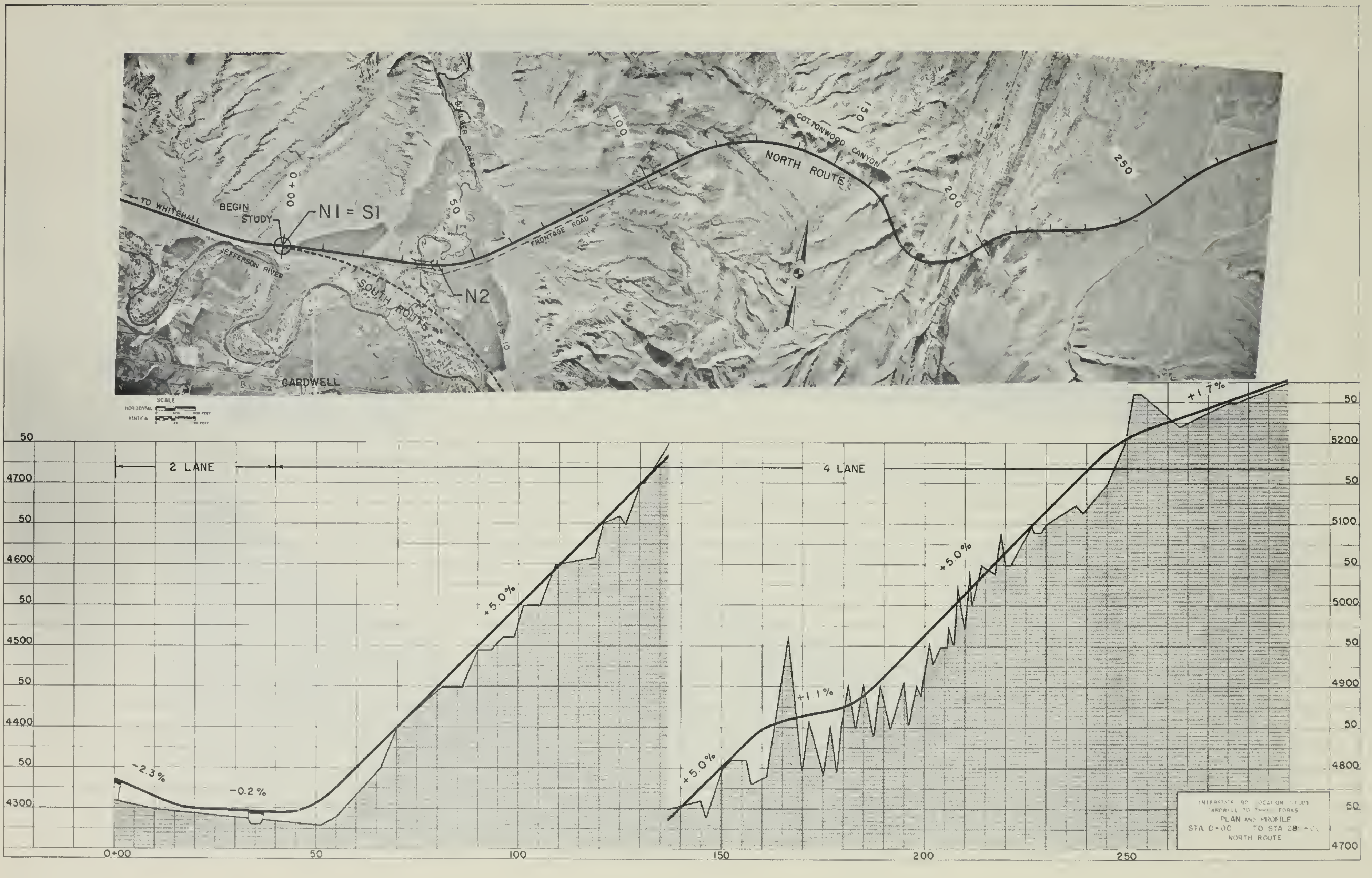
The reconstruction of the present highway to current standards should reduce both maintenance cost figures and the vehicle operating cost figures below the amounts originally computed for Tables 2 and 3. It is estimated that maintenance costs would be reduced by $200 per mile per year during the average life of the highway and the vehicle operating cost figures for the present highway would be reduced by 10%.

These adjustments will result in the following cost figures for each route:

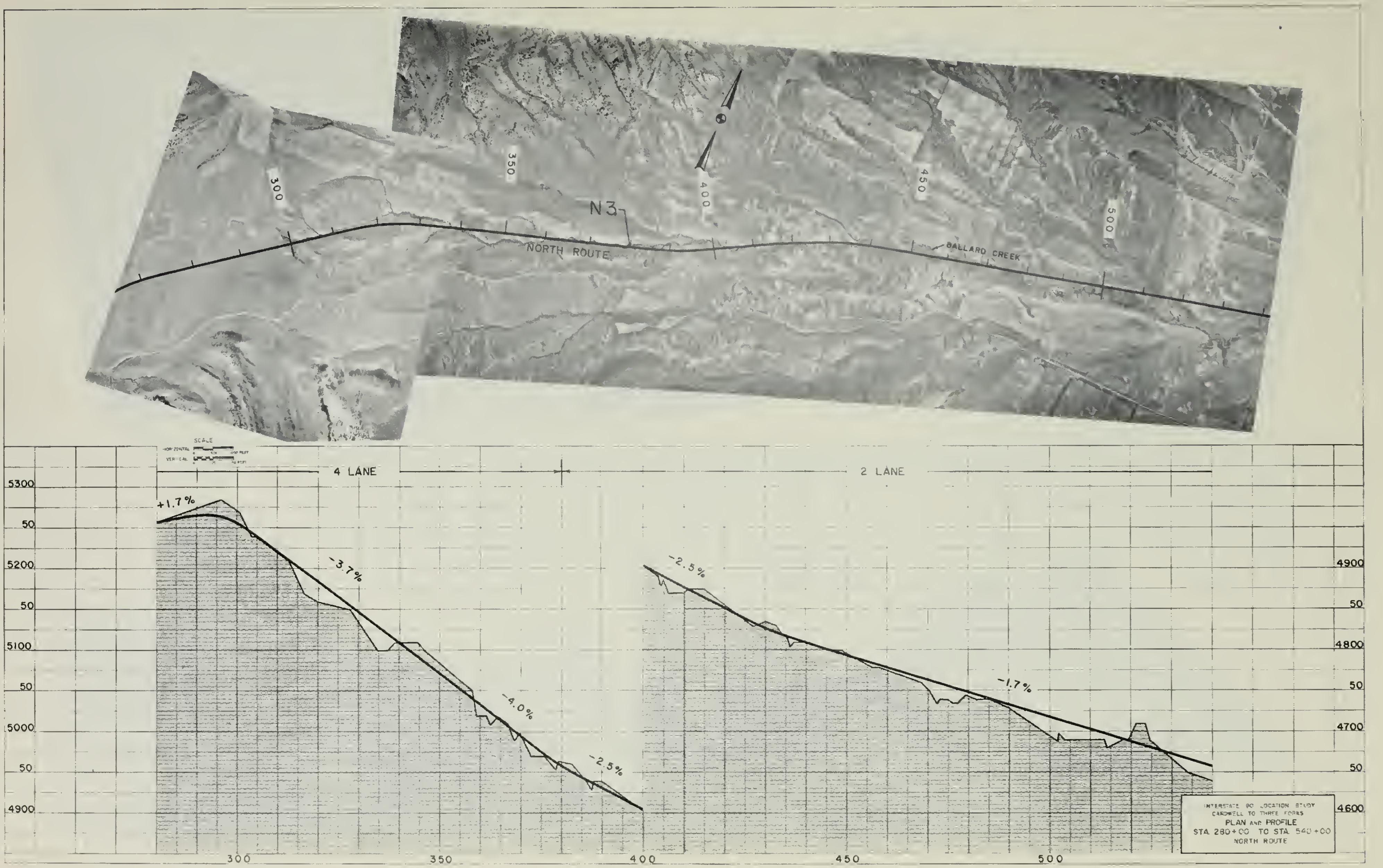
	NORTH ROUTE	SOUTH ROUTE
Annual Construction Costs - Interstate	$ 608,538	$ 981,638
Annual Construction Costs - U.S. # 10	232,646	86,829
Subtotal	841,184	1,068,467
Annual Maintenance Costs	103,829	69,780
Annual Vehicle Operating Costs	1,721,200	1,763,194
TOTAL OF ALL COSTS	$2,666,213	$2,901,441

This table shows that, even if it is considered necessary to reconstruct the present highway, the North Route would still have an advantage over the South Route amounting to $235,228 per year. This is equal to a 9% differential in favor of the North Route.

This is considered to be adequate justification for selecting the North Route location for Interstate Route 90 between Cardwell and Three Forks.



INTERSTATE 90 LOCATION STUDY
CARDWELL TO THREE FORKS
PLAN AND PROFILE
STA 0+00 TO STA 28[illegible]
NORTH ROUTE



INTERSTATE 90 LOCATION STUDY
CARDWELL TO THREE FORKS
PLAN AND PROFILE
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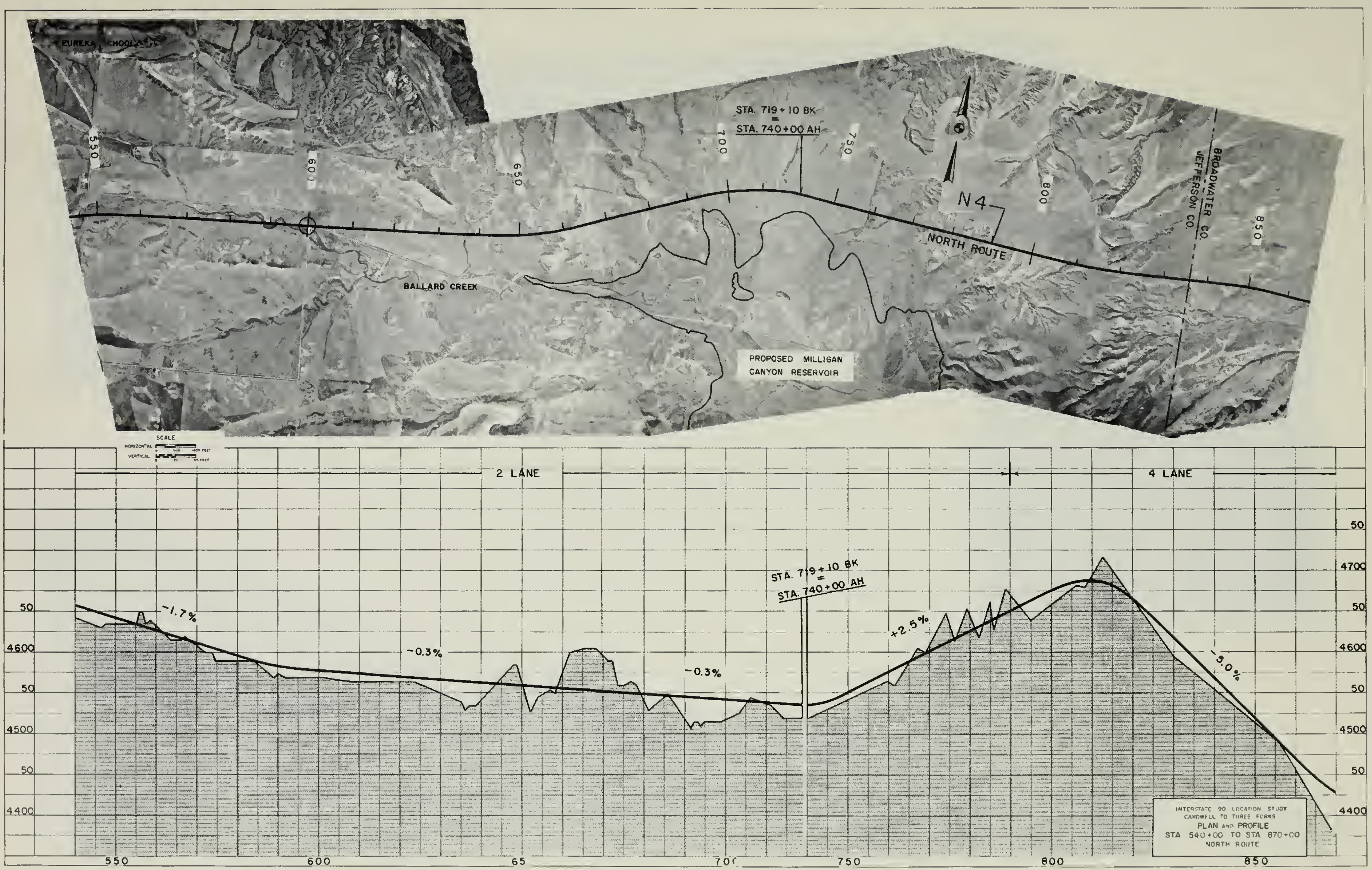

INTERSTATE 90 LOCATION STUDY
CARDWELL TO THREE FORKS
PLAN AND PROFILE
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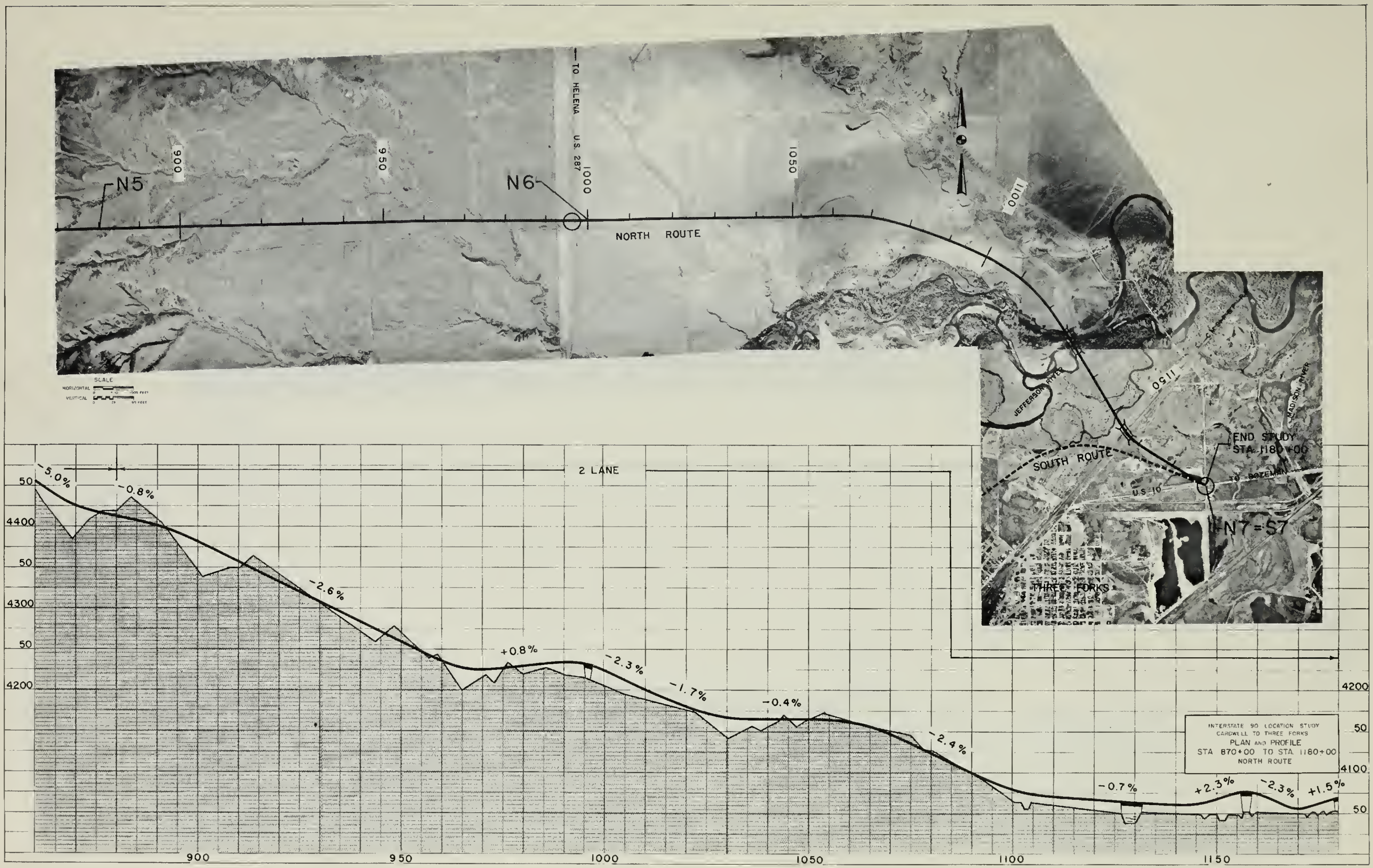
NORTH ROUTE



INTERSTATE 90 LOCATION STUDY
CARDWELL TO THREE FORKS
PLAN AND PROFILE
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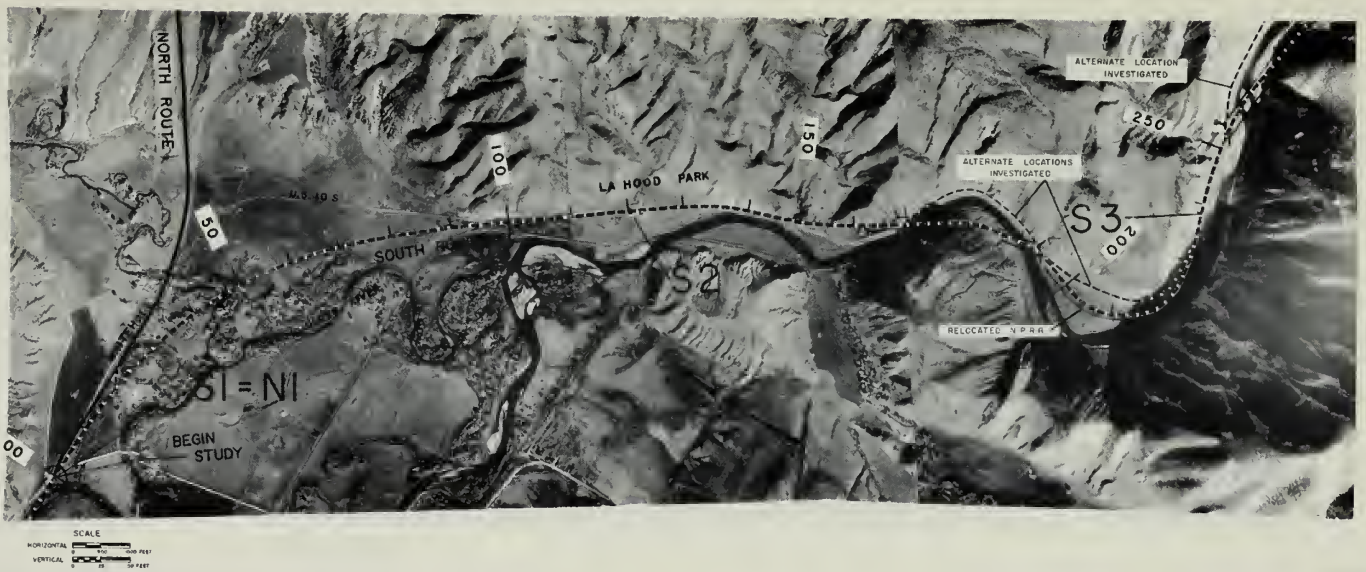
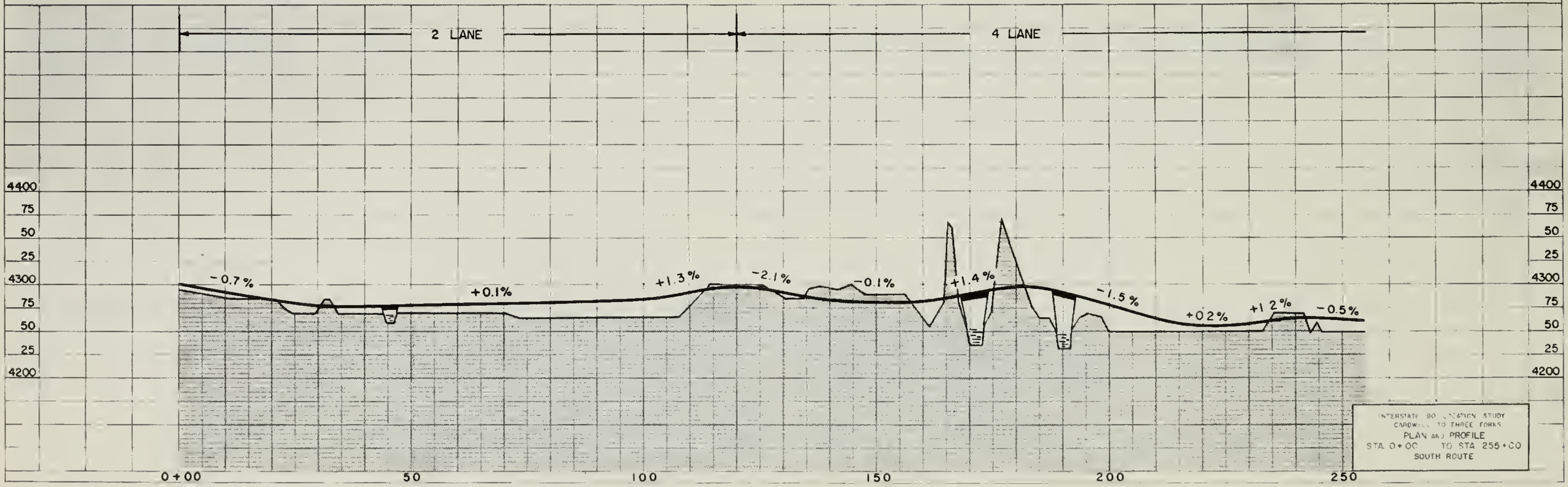
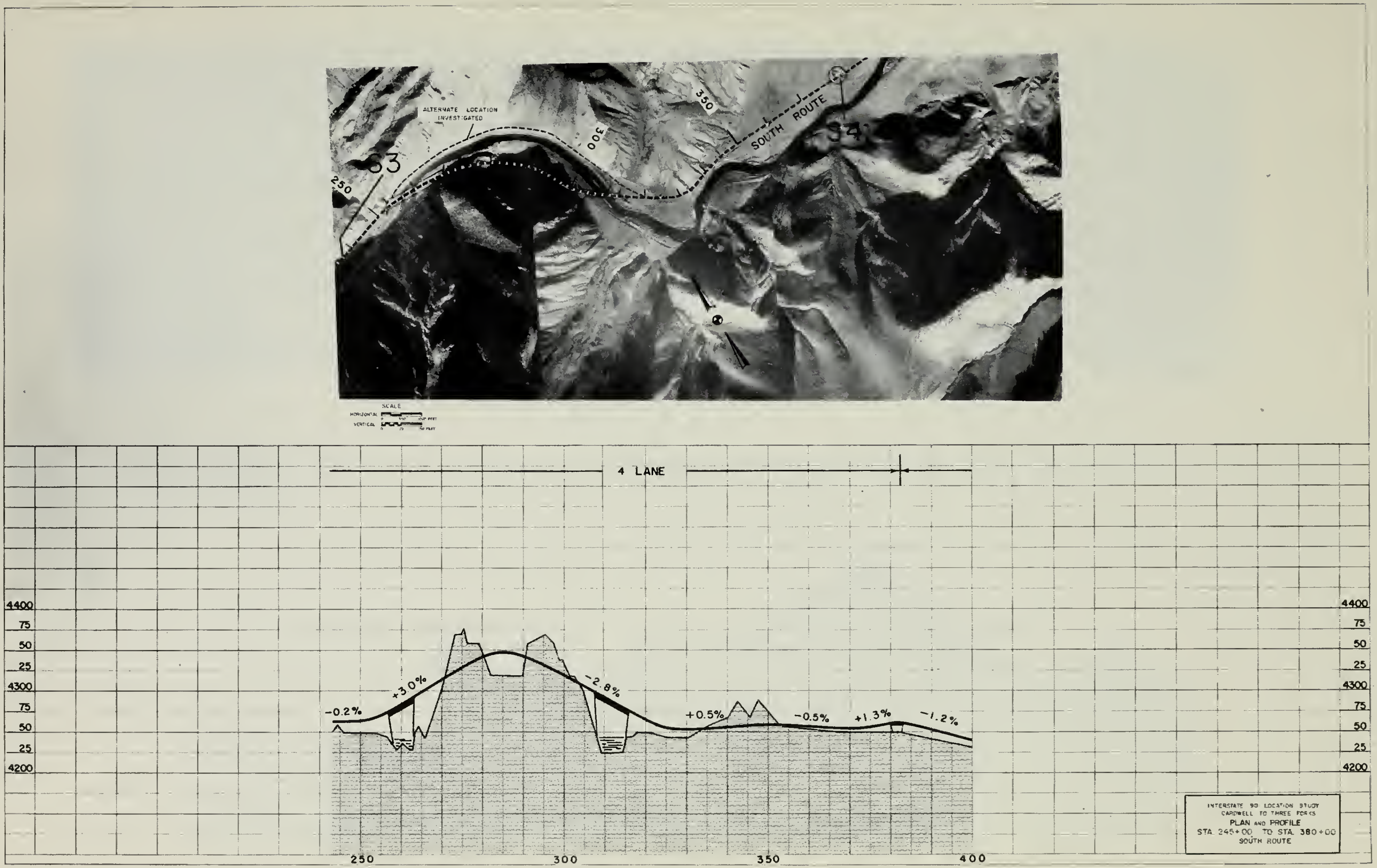
NORTH ROUTE





INTERSTATE 90 LOCATION STUDY
CARDWELL TO THREE FORKS
PLAN AND PROFILE
STA 0+00 TO STA 255+00
SOUTH ROUTE



INTERSTATE 90 LOCATION STUDY
CARDWELL TO THREE FORKS
PLAN AND PROFILE
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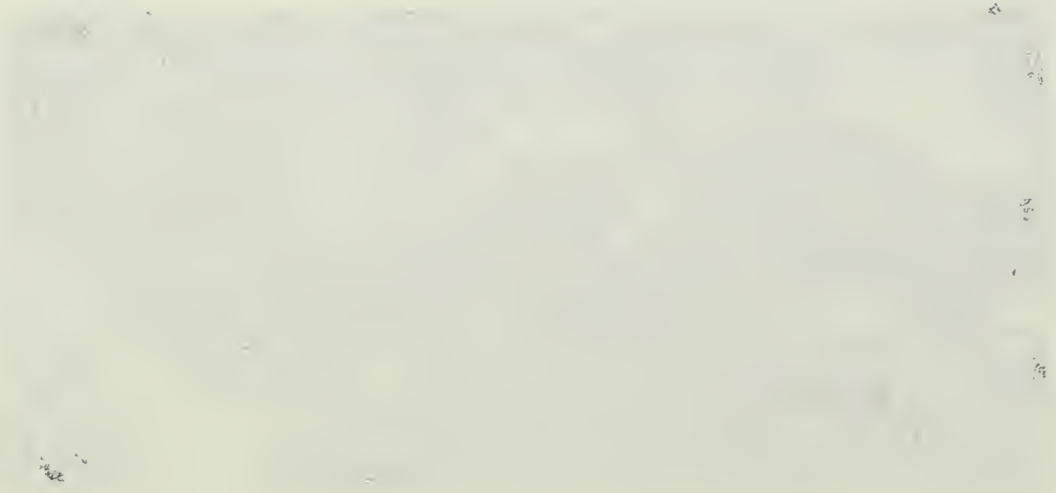
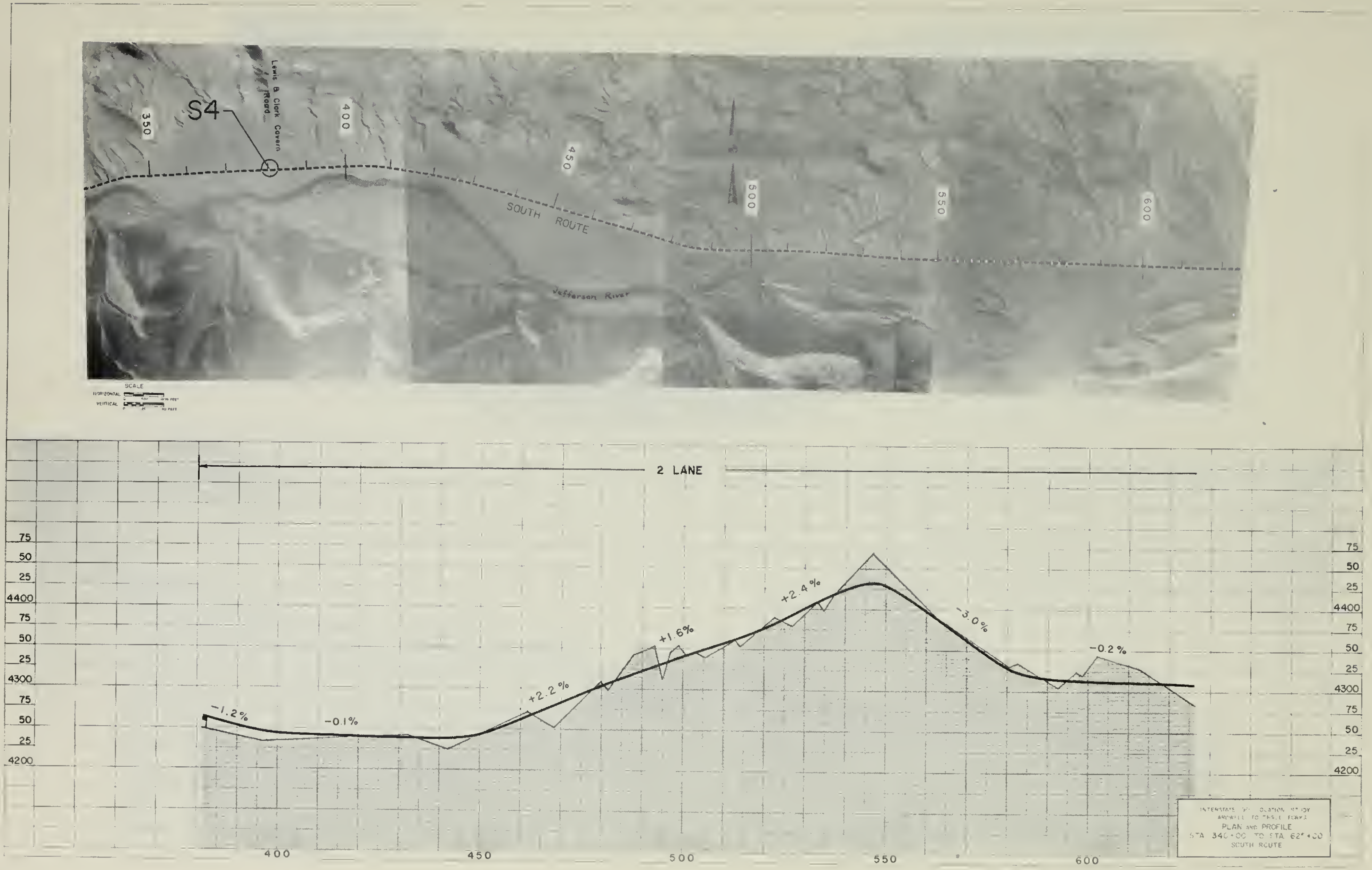
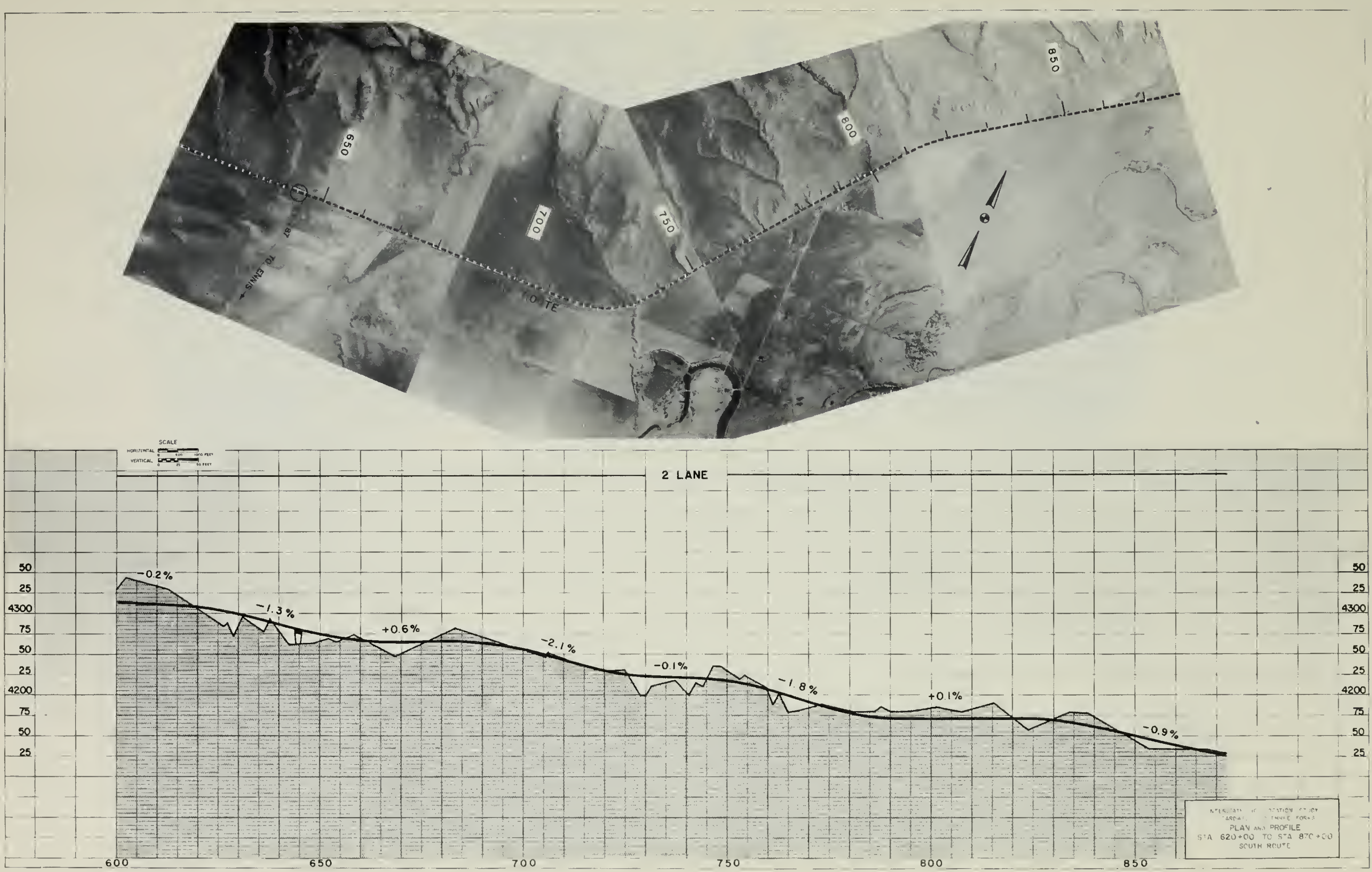




INTERSTATE 90 LOCATION STUDY
CARDWELL TO THREE FORKS
PLAN and PROFILE
STA 340+00 TO STA 625+00
SOUTH ROUTE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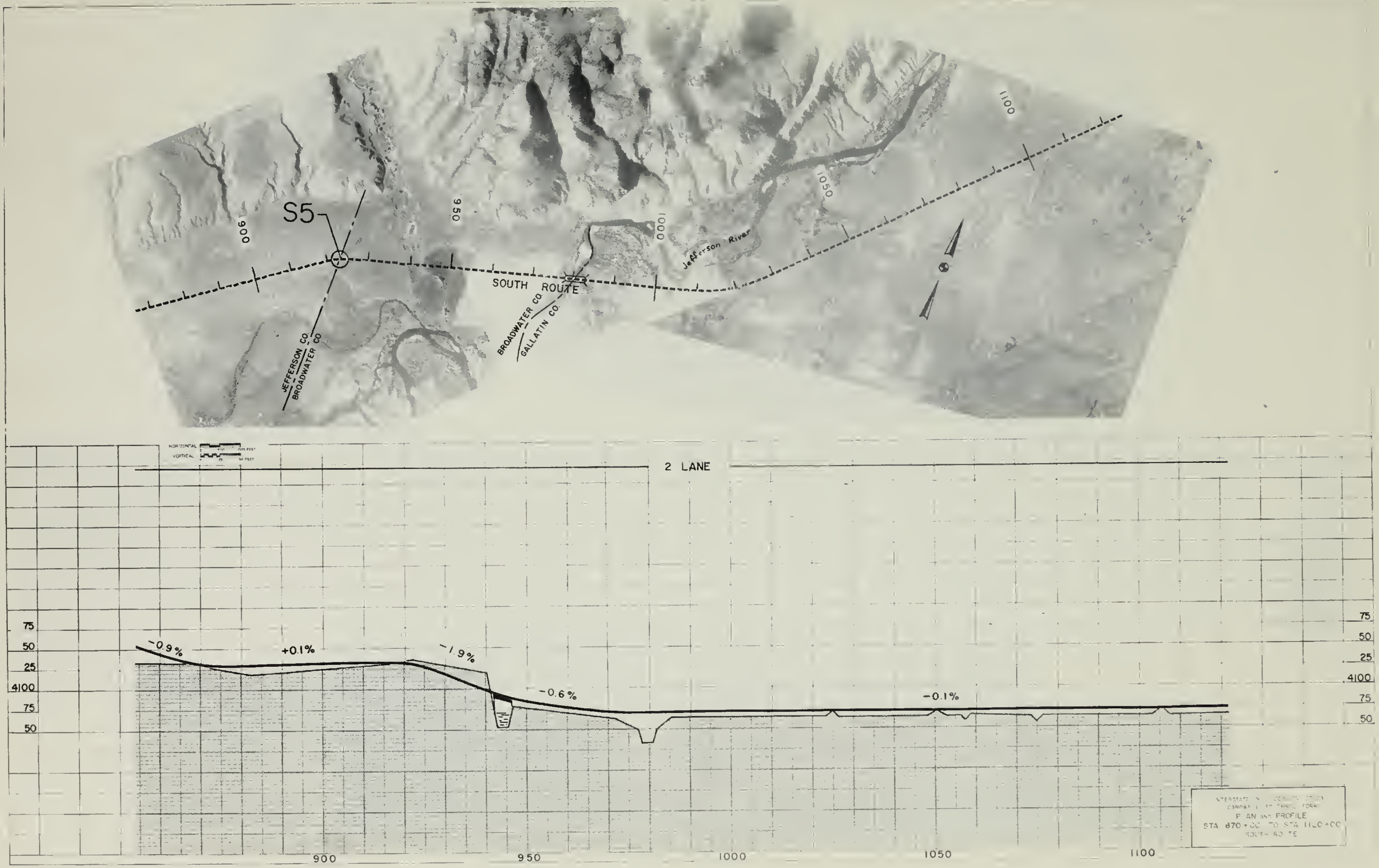
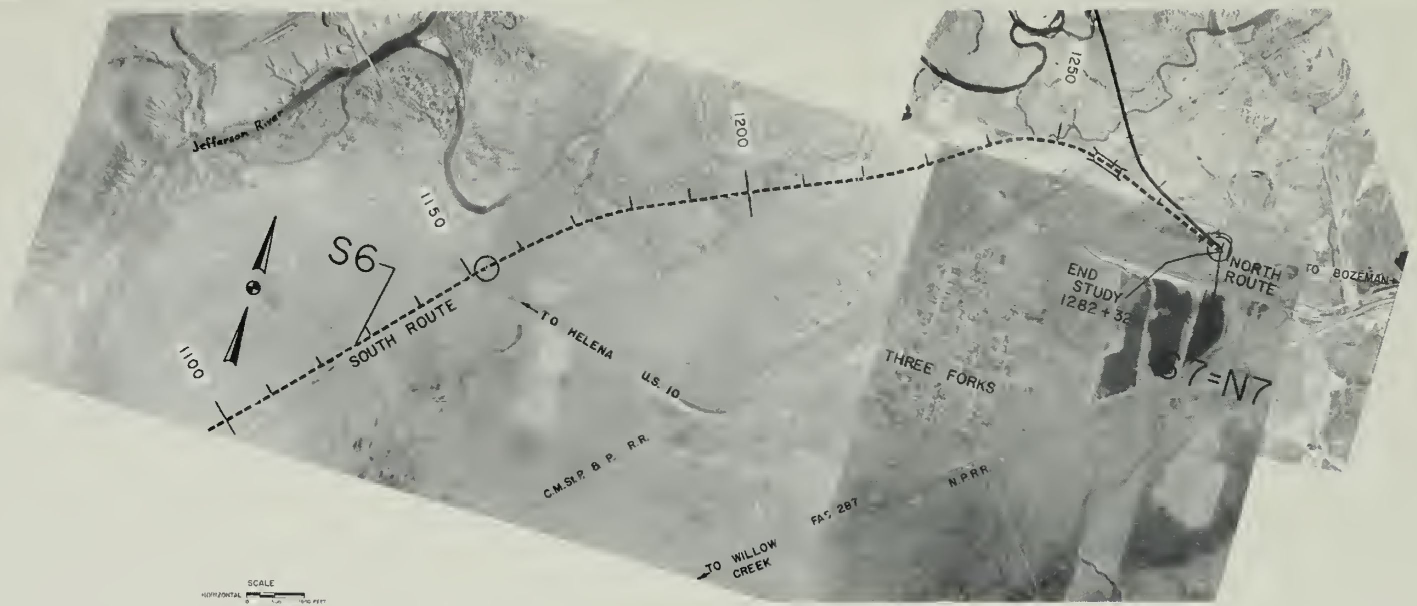
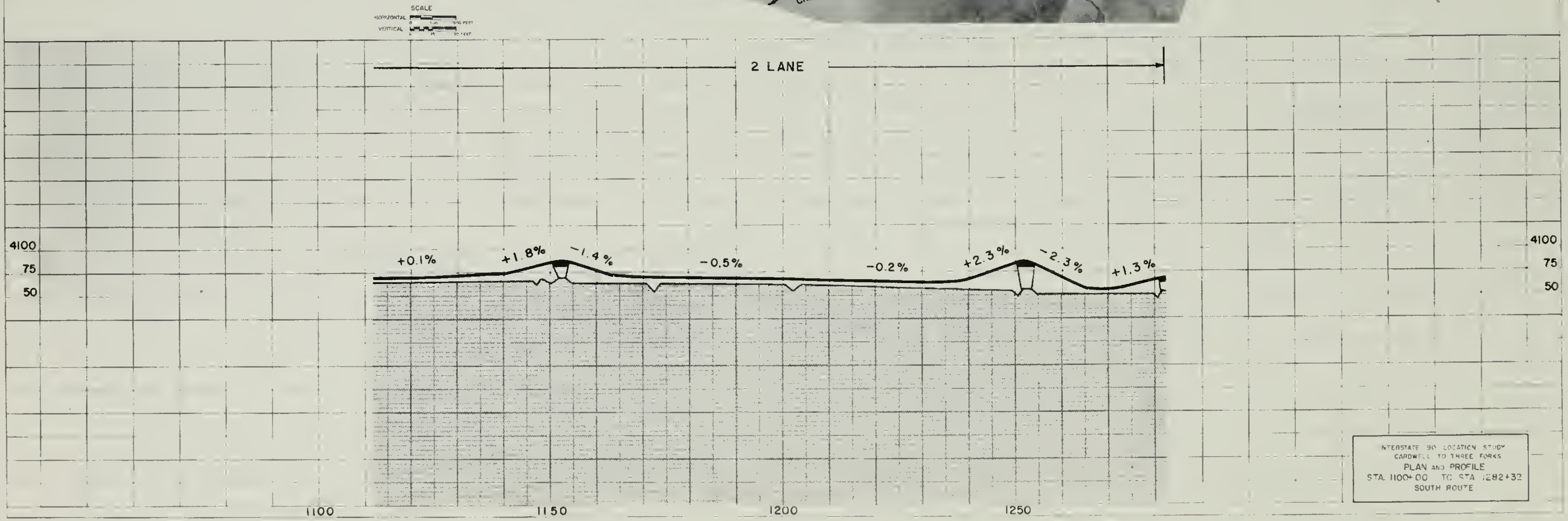
PLAN AND PROFILE
STA 620+00 TO STA 870+00
SOUTH ROUTE



INTERSTATE [illegible]
CARDWELL TO THREE FORKS
PLAN AND PROFILE
STA 870+00 TO STA 1120+00
SOUTH ROUTE





INTERSTATE 90 LOCATION STUDY
CARDWELL TO THREE FORKS
PLAN AND PROFILE
STA 1100+00 TO STA 1282+32
SOUTH ROUTE